



CPUC/CSI Initiative Research, Demo, and Deployment Program, *Grant Solicitation #3*

Screening Distribution Feeders: Alternatives to the 15% Rule

Kristen Nicole

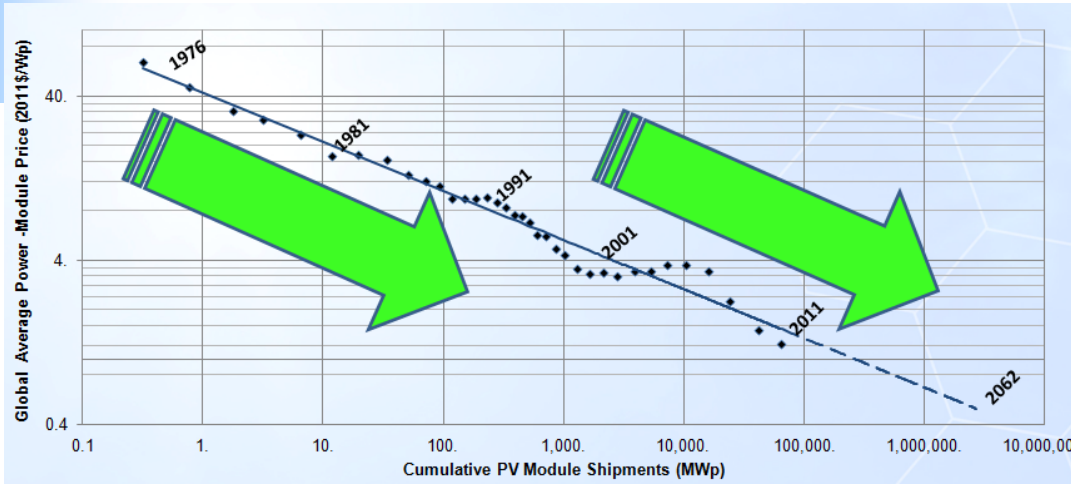
Sept 14, 2012

- Founded in 1972
- Nonprofit institute conducting applied power systems research, development & demonstration
- ***“No policy” policy***
- ***Collaborative Advisory Structure***



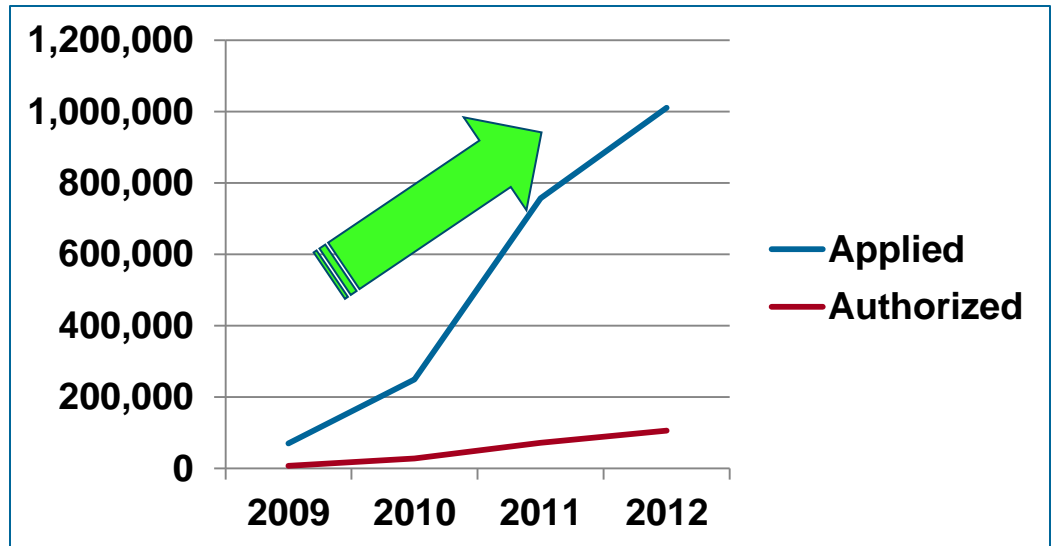
Chauncey Starr
EPRI Founder

“Together...Shaping the Future of Electricity”

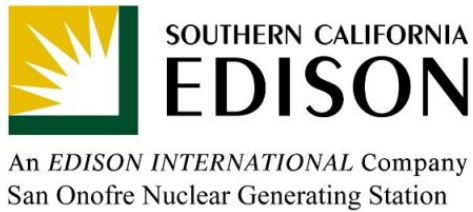


“Free Solar” Thought Experiment

NU/National Grid - DG Applications Submitted vs. Processed Each Year (Cumulative kW)



Project Partners



Project Objective

- **Develop new methods for quickly and accurately determining the capacity of individual feeders to accept new PV projects**
- At a minimum, should take into account
 - Size/location of PV
 - Specific feeder characteristics
- Considering impact on
 - voltage (overvoltage, voltage fluctuations)
 - Protection
 - Thermal loading/reverse power

Why Consider Alternatives to Existing Screening?

- Feeders may have **similar** characteristics that are **typically** used to classify/screen feeders (load level and voltage class)
- Feeder's ability for hosting PV w/o adversely impacting performance depends upon many feeder-specific factors
- Example shown illustrates the difference in hosting capacity for "similar" circuits

Feeder Characteristics	Feeder A	Feeder B
Voltage (kV)	13.2	12.47
Peak Load	5 MW	6 MW
Minimum Load	0.8 MW	0.7 MW
Minimum Daytime Load	1.1 MW	0.7 MW
Existing PV (MW)	1.0	1.7
Feeder Regulation	Only @ Substation	Yes, highly regulated
Total Circuit Miles	28	58
Feeder "Footprint"	7 mi ²	35 mi ²
Minimum Hosting Capacity		
Due to Voltage Impacts	>3500 kW	250 kW
Due to Protection Limit	777 kW	390kW

70% of Peak Load

4% of Peak Load

Overall Approach

- Document the landscape (what is the baseline? What's being done now? What works? What doesn't?)
- Determine the *range* of feeder types in CA
- Performed detailed, high-pen PV analysis on select feeders
- Develop and validate alternate screening method based on findings
- Obtain high-resolution PV production data for model development and screening validation

Task Breakdown

- Task 1: Project Management (EPRI Lead)
- Task 2: Document Current Screening Practices (NREL Lead)
- Task 3: Define Feeder Configurations in CA (Sandia Lead)
- Task 4: Collect High-Resolution Solar Data (EPRI Lead)
- Task 5: Detailed Modeling of Test Feeders (EPRI Lead)
- Task 6: High-Pen PV Analysis (EPRI Lead)
- Task 7: Develop Screening Methodology (EPRI Lead)
- Task 8: Validate Screening Methodology (NREL Lead)

Task 2: Current Screening Practices

- Task Purpose
 - Investigate and document current practices for screening PV interconnection requests among California utilities and from other sources outside California.
- Approach
 - Consideration for federal, state, and local interconnection procedures pertaining to CA (Rule 21, WDAT, SGIP)
 - Consideration for non-CA and European utility screening practices as well

Task 3: Define Feeder Configurations in CA

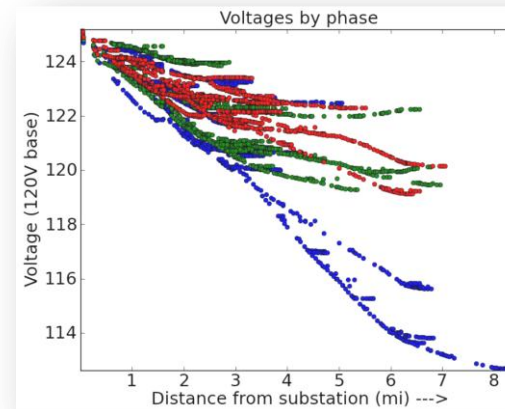
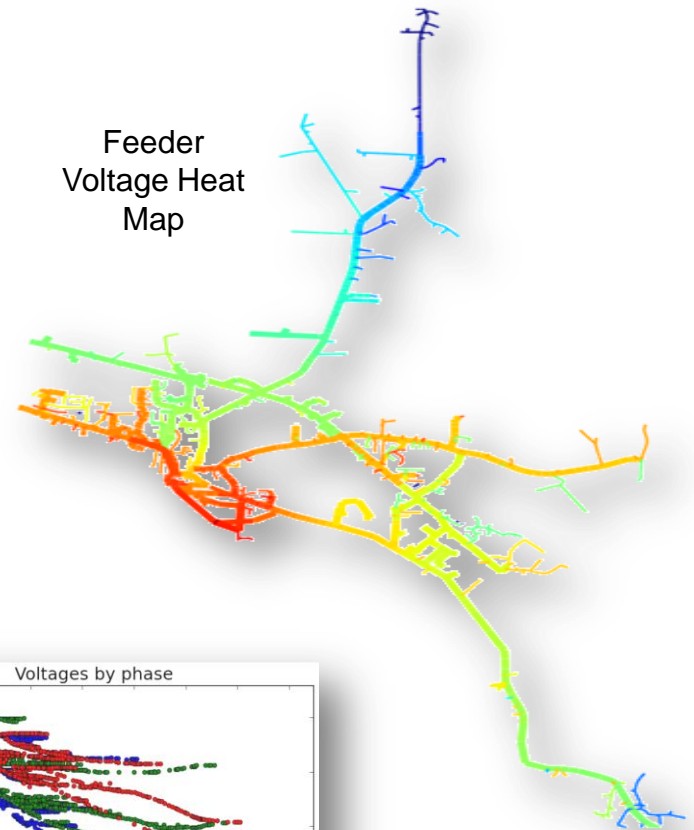
- Purpose of task
 - Determine the range of feeder configurations and characteristics for CA utilities
 - Identify a selection of feeders to be used in developing and validating the proposed screening methodology
- Approach
 - Develop database of feeder characteristics for statistical processing
 - Identify 20 feeders representative of range of Dx feeders in CA
 - 15 Test Feeders for methodology development
 - 5 Control Feeders for methodology validation
 - Will require each utility to provide feeder-characteristics data on Dx feeders throughout their service territory

Task 4: Collect High-Resolution Solar Data

- Purpose of Task
 - Collect high-resolution, time-series solar data that can be used for
 - Model validation
 - Defining PV output for modeling of high-penetration PV scenarios
 - Validation of screening approach
- Approach
 - From selecting feeders ID'd in Task 3, obtain high-resolution (1-sec) PV production data via new monitors and/or existing monitoring systems
 - Will require each utility member to install pole-mount and existing PV facility monitoring equipment (provided by EPRI)

Task 5: Detailed Modeling of Test Feeders

- Purpose of Task
 - Develop detailed distribution feeder models for the test group and control group of feeders
- Approach
 - Work with participating utility to obtain feeder data (incl. underlying model and auxiliary data)
 - Convert model to OpenDSS
 - Validate/verify model w/ measurement data



Simulation Platform -- OpenDSS

- ❑ Open source of EPRI's Distribution System Simulator
 - ❑ developed in 1997
 - ❑ open sourced in 2008 to collaborate with other research projects

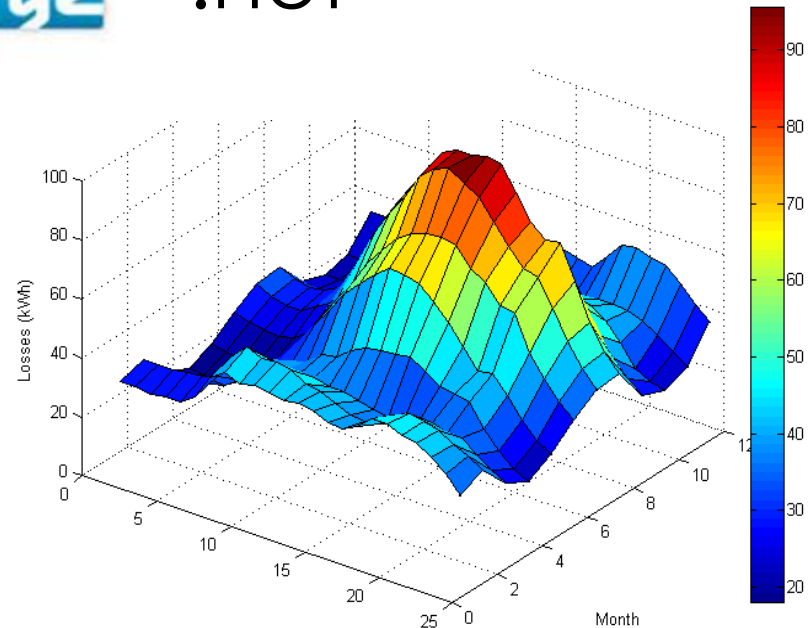
- ❑ Needed for analysis of
 - ❑ DG/renewables
 - ❑ energy efficiency
 - ❑ PHEV/EV

apes

- ❑ OpenDSS design beginning to capture
 - ❑ Time-specific benefits and
 - ❑ Location-specific benefits

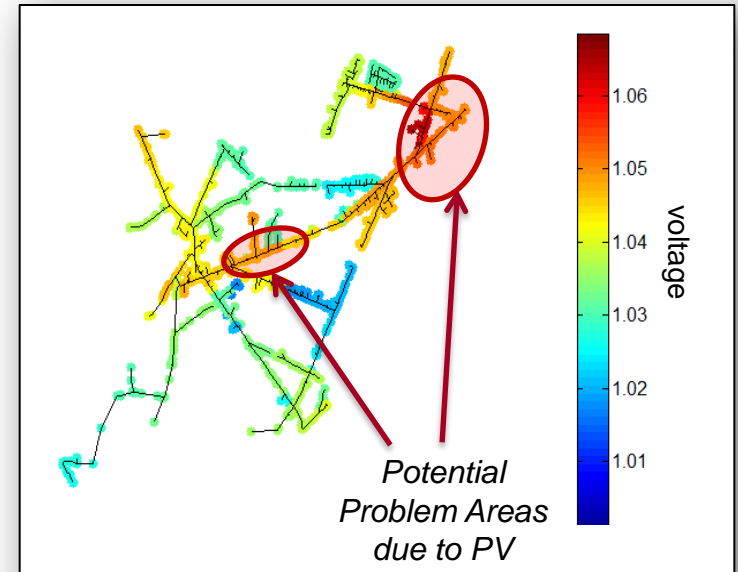
- ❑ Differentiating features
 - ❑ full multiphase model
 - ❑ numerous solution modes
 - ❑ dynamic power flow
 - ❑ system controls
 - ❑ flexible load models

sourceforge .net



Task 6: High-Pen PV Analysis

- Purpose of Task
 - Perform high-penetration assessment of the test feeders to determine each specific feeder's hosting capacity for solar PV
- Approach
 - Utilize EPRI's Distributed PV (DPV) Feeder Analysis Approach for determining feeder impacts and hosting capacity
 - Simulate a wide range of PV deployment scenarios and penetration levels on each feeder and present to utility
 - Aggregate results from test set of feeders



Task 7/8: Develop and Validate Screening Methodology

- Purpose of Tasks
 - Develop and validate a practical screening criterion for evaluating new interconnection requests
- Approach
 - Using results from Task 6, analyze key factors that result in maximum and minimum hosting capacity for PV
 - Develop screening methodology/approach
 - Validate approach using control group of feeders and corresponding modeling and measurement data

Hosting Capacity

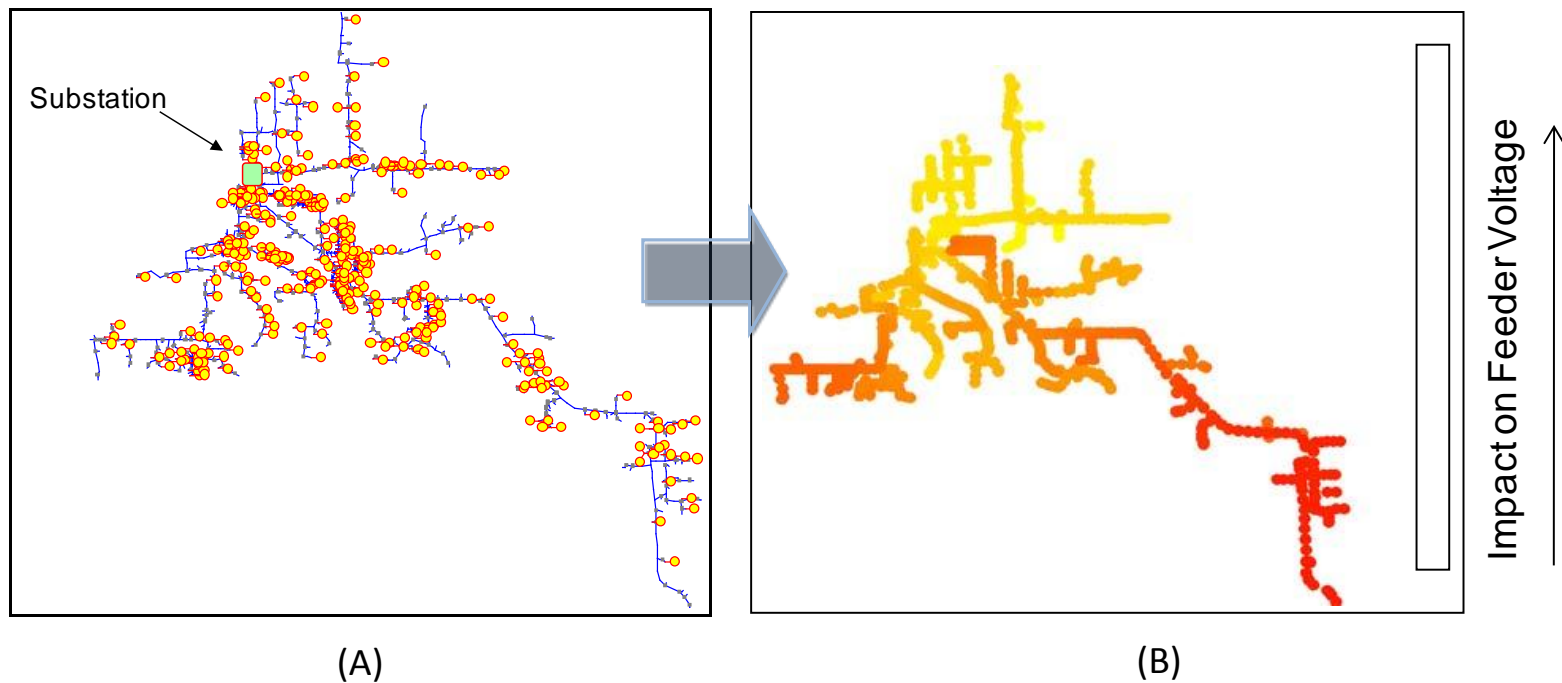


Figure 2 Feeder Model with Distributed PV (A) and Resulting Voltage Impacts Resulting from High Penetration²

Schedule

Project Approach and Scope of Work		Year 1												Year 2											
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Task 1	Project management, reporting, technology transfer, and outreach																								
Task 2	Document current utility screening practices and available tools																								
Task 3	Define distribution feeder characteristics in California																								
Task 4	Collect high-resolution PV output data for use in feeder impact simulations																								
Task 5	Complete detailed modeling for selected feeders with participating CA utilities																								
Task 6	Run full range of high penetration PV scenarios on selected feeders																								
Task 7	Develop practical screening method for handling new interconnection requests																								
Task 8	Validate screening method using site measurement and specific feeder data																								

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